

1 **METHOD AND APPARATUS FOR ADHESIVELY BONDING**
2 **CORNER PROTECTORS ONTO PICTURE FRAMES AND THE LIKE**

3 **BACKGROUND OF THE INVENTION**

4 A. Field of the Invention

5 The present invention relates to methods and apparatus for protecting the
6 corners of rectangularly-shaped frames such as picture frames, from impact damage during
7 shipping. More particularly, the invention relates to a method and apparatus for adhesively
8 bonding corner protectors onto the corners of a picture frame.

9 B. Description of Background Art

10 Picture frames for holding and displaying paintings, photographs, diplomas, certificates and
11 similar flat articles are manufactured in prodigious quantities worldwide. Although picture
12 frames vary in shape and construction details, most frames have a rectangular plan view
13 shape. Moreover, the structure of most picture frames consists essentially of four elongated,
14 straight channel members or moldings, each having formed therein an inner longitudinally
15 disposed channel that intersects channels of adjacent members at ninety degree angles. Four
16 such channel members fastened together form a rectangular ring-shaped frame. The
17 channels or recesses in the moldings face inwardly of the frame, and comprise spaces for
18 receiving a rectangularly-shaped flat display piece such as a photograph or painting, and
19 sometimes, a backing panel, mat and protective cover glass.

20 Picture frames of the type described above are made from a variety of materials
21 including, wood, metal and plastic. Whatever material the frame is made of, the geometry of
22 a rectangular picture frame dictates that it have four peripheral members or moldings of
23 generally uniform thickness which are joined to each other at forty-five degree miter angles to
24 form ninety-degree corners. Since the sides of each molding intersect at an acute angle, i.e.,
25 45 degrees, the frame corners as well as the molding corners are sharp, and are therefore
26 highly subject to breakage, denting or cosmetic damage during shipment. Accordingly, most
27 picture frames, whether empty or occupied, are fitted with some sort of corner protectors
28 during shipment. Such corner protectors are usually made of a relatively inexpensive

1 recyclable material such as cardboard or polystyrene foam. Typical corner protectors of this
2 type are disclosed in U.S. Pat. Nos. 3,955,677, 4,598,825, and 5,447,233. Other patents,
3 related to protecting corners of objects during shipping include U.S. Pat. No. 4,407,898. Also,
4 U.S. Pat. No. 5,255,458 discloses a three-dimensional picture corner and U.S. Pat. No.
5 4,787,553 discloses a corner fastening device.

6 In addition to the above-referenced patents related to corner protectors and the
7 like, a variety of machines for bending sheet metal or cardboard of the type used for corner
8 projectors have been disclosed in the following U.S. Pat. Nos: 4,132,102, 4,585,432,
9 4,713,957, 4,857,038, 4,956,961, and 5,184,998.

10 None of the aforementioned references disclose a machine for automatically
11 attaching corner protectors to picture frames. Accordingly, the task of attaching corner
12 protectors to picture frames was formerly labor intensive and time consuming. In response to
13 those limitations of the prior art, the present inventor disclosed an automatic Method and
14 Apparatus For Attaching Corner Protectors to Picture Frames, in U.S. Patent No. 6,018,934.
15 In that patent, the present inventor disclosed a method and apparatus for installing covers to
16 protect picture frame corners from damage during shipment, utilizing thin cardboard preforms
17 having symmetric, left and right-hand, right-triangular cover flaps joined at vertical sides thereof
18 to opposite vertical sides of a vertically elongated, rectangular spine flap, the left-hand
19 triangular cover flap having depending downwardly from its base a horizontally elongated
20 rectangular side cover flap, and depending downwardly from the lower lateral edge of the side
21 cover flap a trapezoidally-shaped securement flap. The preform is positioned below a picture
22 frame corner, with intersecting side members of the frame vertically aligned with the sides of
23 the left-hand right-triangular cover flap, which serves as a lower face cover flap. The
24 apparatus includes folder mechanisms including flap folder arms which are retractable into
25 recesses provided in a work table, and which are extendible and rotatable to thereby bend the
26 side cover flap and securement flap into a vertical position adjacent a first side of the frame
27 corner and perpendicularly inwardly to overlie the first frame member, bend the spine flap and
28 right-hand triangular cover flap into a vertical position adjacent the second frame member, and

1 bend the right-hand triangular flap perpendicularly inwards from the spine flap to overlie the
2 second and first frame members. An automatic staple gun then inserts a staple downwardly
3 through the right-triangular cover flap into the securement flap and left-hand frame member,
4 securing the corner protector in a folded disposition over the frame corner. The present
5 invention was conceived of to provide a method and apparatus for adhesively bonding corner
6 protectors on the corners of picture frames, the method and apparatus being suitable for use
7 with picture frames made of metal or plastic, as well as wood.

8 OBJECTS OF THE INVENTION

9 An object of the present invention is to provide a method for attaching protective
10 covers to the corners of a picture frame, using an adhesive bonding process.

11 Another object of the invention is to provide an apparatus for automatically
12 attaching protective covers to the corners of picture frames using adhesive bonds.

13 Another object of the invention is to provide a method and apparatus for
14 automatically attaching protective covers to the corners of picture frames, in which a cover is
15 bonded to the corner of a frame by an adhesive bond, not requiring penetration of the frame
16 by a fastener.

17 Another object of the invention is to provide a method and apparatus for
18 automatically attaching protective covers to corners of a picture frame in which adhesive is
19 applied to a surface of a frame molding, a protective cover is positioned over the cover, and
20 the cover pressed against the adhesive to bond the cover to the frame molding.

21 Another object of the invention is to provide an apparatus for depositing a
22 quantity of adhesive on a surface of a picture frame molding, folding a flat sheet of flexible
23 material over the corner of a picture frame, depositing a quantity of adhesive on a surface of
24 the sheet, securing the folds of the sheet together by pressing an upper portion of the folded
25 sheet against a lower portion having adhesive on its surface to form a protective cover, and
26 adhering the cover to the picture frame by pressing the cover against adhesive on the molding
27 surface.
28

1 Another object of the invention is to provide an apparatus for bending a
2 cardboard preform cut to a pre-determined shape over the corner of the picture frame,
3 securing the folded portions of the cardboard preform by compressing a liquid adhesive
4 therebetween and allowing the liquid adhesive to solidify, thereby forming a corner protector,
5 and securing the corner protector to a molding of the frame by compressing a liquid adhesive
6 between the molding and corner protector and allowing the liquid adhesive to solidify, thereby
7 adhesively bonding the corner protector to the frame.

8 Another object of the invention is to provide a picture frame corner protector
9 attaching apparatus which includes means for clamping and holding a corner of a picture
10 frame, positioning under the picture frame corner a preform sheet of flexible material, the
11 preform sheet having the shape of left and right, lower and upper right triangular-shaped cover
12 flaps joined at their inner vertical edges by a vertically elongated, rectangular-shaped inner
13 spine flap to form a shape approximating that of a truncated isosceles triangle, the preform
14 having a horizontally elongated, rectangularly-shaped outer spine flap depending downwardly
15 from the left triangular corner flap and shaped similarly to the inner spine flap, and having
16 depending downwardly therefrom a trapizoidally-shaped securement flap, means for spraying
17 a first quantity of adhesive onto the upper surface of a first frame molding overlying the lower
18 triangular-shaped cover flap, bending the outer spine flap vertically upwards into contact with
19 the outer lateral side of the first frame molding, bending the securement flap down into a
20 horizontal position in contact with the adhesive on the surface of the first frame molding,
21 bending the inner spine flap and upper triangular cover flap vertically upwards into contact with
22 the outer lateral surface of the second frame molding, spraying a second quantity of adhesive
23 onto the upper surface of the securement flap overlying the first quantity of adhesive and
24 bending the upper triangular cover flap into compressive contact with the second quantity of
25 adhesive, thereby securing the upper triangular cover flap to the securement flap to form a
26 completed cover protector, and pressing the first quantity of adhesive between the lower
27 surface of the securement flap and the upper surface of the first frame molding to thereby
28 secure the corner protector to the frame.

Various other objects and advantages of the present invention, and its most novel features, will become apparent to those skilled in the art by perusing the accompanying specification, drawings and claims.

It is to be understood that although the invention disclosed herein is fully capable of achieving the objects and providing the advantages described, the characteristics of the invention described herein are merely illustrative of the preferred embodiments. Accordingly, I do not intend that the scope of my exclusive rights and privileges in the invention be limited to details of the embodiments described. I do intend that equivalents, adaptations and modifications of the invention reasonably inferable from the description contained herein be included within the scope of the invention as defined by the appended claims.

SUMMARY OF THE INVENTION

Briefly stated the present invention comprehends a method and apparatus for automatically and adhesively bonding protective covers made of a sheet of flexible material, e.g., cardboard, stock to the corners of frames, particularly rectangularly-shaped frames of the type used to hold pictures, documents and the like, the covers being intended to protect the corners of the frame from damage during shipment.

A preferred embodiment of an automatic adhesive bonding method and apparatus according to the present invention preferably utilizes corner protectors made from thin, flat sheets of cardboard, each pre-cut, by die cutting, for example, into a generally triangular shape which includes panel sections which are bent out from the plane of the sheet to form cover flaps which are to be folded over and enclose a corner and adjacent portions of the side channel members of a conventional rectangularly-shaped picture frame. Four such corner protectors are used to cover the four corners of the frame.

In a preferred embodiment of the invention, the plan view shape of the upper, larger portion of the corner protector preform includes two mirror symmetric, left and right, right-triangularly-shaped, panel sections having collinear horizontal bases joined to opposite vertical sides of a vertically elongated rectangular, inner, or right-hand spine panel section. The left and right triangularly-shaped panel sections serve as lower and upper cover flaps,

1 while the inner spine panel section serves as a first, right-hand spine cover flap for a picture
2 frame corner, as will be described below. Thus shaped, the upper portion of the preform has
3 the appearance of an isosceles triangle whose vertex is horizontally truncated. The preform
4 preferably includes a lower portion that has a horizontally elongated, rectangularly shaped
5 outer, or left-hand spine flap panel section which depends downwardly from the base of one
6 of the right-triangle flap panels, the left one, for example, and has the same width as that
7 panel. A trapezoidally-shaped securement flap panel section depends downwardly from the
8 bottom edge of the outer spine flap panel, the securement flap panel having a lower edge wall
9 parallel to but shorter than that of the outer spine flap panel. In a preferred embodiment, the
10 horizontal width of the vertically elongated inner spine flap panel and the vertical height of the
11 horizontally elongated outer spine flap panel have a common value which is slightly greater
12 than the thickness of a picture frame which is to be protected, e.g., about 15/16 inch for a
13 frame thickness of 5/8 inch. Preferably, the vertical side walls of the vertical inner spine flap
14 panel and the horizontally disposed upper and lower edges of the outer spine flap panel are
15 scored to facilitate folding those respective flaps to contact adjacent perpendicular channel
16 members or moldings of a picture frame.

17 According to the method of the present invention, a preform, score lines up, is
18 positioned below a corner of a picture frame. The corner of the frame is oriented with respect
19 to a preform with a pair of perpendicularly intersecting adjacent molding side walls defining
20 the corner of the frame vertically aligned with the perpendicular sides of the left-hand, lower
21 right-triangular cover flap having the downwardly depending outer spine and securement flaps.
22 A first quantity of adhesive is then deposited on the upper surface of left-hand frame molding,
23 near its intersection with the right-hand frame molding. Preferably, the first quantity of
24 adhesive consists of one or more blobs of molten hot melt adhesive sprayed onto the upper
25 surface of the molding from one or more nozzles of a pressurized hot melt glue gun positioned
26 above the frame. The outer spine flap and securement flap are then folded vertically upwards
27 as a planar unit along the upper or inner score line defining the junction between the base of
28 the left, lower, right triangularly-shaped lower cover flap and the outer spine flap. Next, the

securement flap is folded downwardly and inwardly along the lower or outer score line towards a horizontal position, and the securement flap is pressed down onto the semi-liquid glue blobs on the upper surface of the frame member overlying the left, lower triangularly-shaped cover flap. A second quantity of adhesive is then deposited on the upper surface of the securement flap by the glue gun. Then, the second, right-hand, right-triangularly-shaped upper cover flap and inner spine flap are bent upwards as a unit along the innermost vertical fold line, i.e., the left-hand vertical edge of the inner spine flap, to a vertical position. The right-hand, upper triangular cover flap is then bent downwardly and laterally along the outermost, right-hand vertical fold line of the inner spine flap to a horizontal position overlying the securement flap and pressed down against the second quantity of adhesive on the upper surface of the securement flap, thus securing the overlying, upper right-hand triangular cover flap to the securement flap.

The apparatus according to the present invention includes a base plate or work table having a flat upper surface for supporting a corner of a picture frame, and a frame holder clamping jig for receiving and holding the corner of the picture frame on the surface of the table.

Mounted on the table is a corner protector installation mechanism which includes a pair of corner protector flap folder actuators positioned on opposite sides of the corner of a picture frame held in the clamping jig. Each corner folder actuator includes a flat, rectangularly-shaped flap-contacting arm mounted near a longitudinal end thereof on the upper end of a post which is actuatable by a linear actuator from a lower inactive position in which the arm resides within a rectangularly-shaped recess in the upper surface of the base plate, with the upper surface of the arm flush with the upper surface of the base plate, to an upper, active position. Each post also includes a 90-degree rotary actuator means, which is effective in rotating a flap contacting arm, when raised, from an outer position contacting the outer vertically disposed side of a flap to an inner position effective in exerting an inwardly and downwardly directed folding force on the flap.

In operation, the first corner folder actuator arm is extended vertically, folding the outer spine flap and securement flap upwardly into a vertical position adjacent one side of a frame. An automatic hot melt adhesive gun applicator head having nozzles pressurized by air then deposits sprays a first quantity of hot melt adhesive onto the upper surface of the frame molding adjacent to the first folder actuator arm. The arm is then rotated inwards, bending the securement flap inwardly and downwardly into contact with the first quantity of semi-liquid adhesive on the upper surface of the first frame molding strip, thus bonding the securement flap to the frame.

Next, the actuator arm of the second corner folder actuator is elevated, folding the upper triangular corner protector flap upwardly to a position vertically adjacent the outer edge of the second frame molding strip. The arm of the first corner folder actuator is then rotated outwardly from its position overlying and holding down the securement flap. A second quantity of molten hot melt adhesive is then sprayed onto the upper surface of the securement flap. The arm of the second actuator is then rotated inwardly, bending the upper triangular cover flap down into contact with the securement flap. This action presses the upper triangular cover flap down against the second quantity of adhesive on the upper surface of the underlying securement flap, thereby securing adhering the flaps to each other. The applicator head is then moved forcibly downwards by a pneumatic actuator, causing a pair of fingers protruding downwardly from the head to press downwardly on the upper surface of the upper triangular cover flap, causing secure adhesive bonds to be formed between the securement flap and frame, and between the upper triangular cover flap and securement flap. Both actuator arms are then automatically rotated and retracted to their recessed positions, flush with the work table surface. At the same time, the frame holding clamp is also automatically released, allowing the frame with attached corner protector to be removed from the clamp.

The apparatus according to the present invention may optionally include means for automatically and substantially simultaneously initiating operation of a pair of corner protector installation mechanisms of the type described above, each time two adjacent corners of a picture frame are fully inserted into and correctly oriented with respect to clamping jigs of

1 the mechanisms. In a preferred embodiment, apparatus components for implementing this
2 automatic operation include a pair of guide plates in each clamping jig that have inner vertically
3 disposed wall surfaces that define therebetween a ninety degree intersection angle or vertex,
4 which is cut off or truncated by a plane oriented at forty-five degrees to the guide bars, to
5 thereby form an opening for insertably receiving the corner of picture frame, with the
6 intersecting channel moldings of the frame aligned with the guide plates.

7 Each guide plate is provided, near the opening between the inner longitudinal
8 ends of the guide plate, with a sensor which provides an electrical signal indicating that a
9 frame corner molding has been fully inserted into the clamping jig. The electrical signals from
10 each pair of sensors for each of the two clamping jigs are logically ANDed, producing a
11 command signal to initiate automatic operation of the machine only when all three outer sides
12 of the frame channel moldings defining two adjacent corners of the frame are fully inserted into
13 and properly aligned with the guide plates of the two clamping jigs for proper operation of the
14 corner protector folding and attaching operation. This command signal initiates a sequence
15 of operations by which a pair of corner protectors are automatically attached in tandem to the
16 two corners of a picture frame. Upon completion of this automatic operation, the holding
17 clamps of both clamping jigs are automatically released, allowing the frame with a pair of
18 attached corner protectors installed to be withdrawn from engagement with the apparatus. The
19 frame may then be rotated one hundred and eighty degrees in a horizontal plane, and re-
20 inserted into the apparatus to initiate attachment of a pair of corner protectors to the remaining
21 two corners of the picture frame.

22 BRIEF DESCRIPTION OF THE DRAWINGS

23 Figure 1 is a front perspective view of an apparatus for adhesively bonding corner
24 protectors onto picture frames according to the present invention, showing a hot melt adhesive
25 machine comprising part of the apparatus.

26 Figure 2 is a fragmentary upper rear perspective view of the apparatus of Figure
27 1 on an enlarged scale, and showing guide rods and preforms used therewith removed to
28 show details of the apparatus.

1 Figure 3 is a front perspective view of an adhesive applicator head comprising
2 part of the apparatus of Figure 1.

3 Figure 4 is a front elevation view of the applicator head of Figure 3.

4 Figure 5 is a side elevation view of the applicator head of Figure 3.

5 Figure 6 is a lower plan view of the applicator head of Figure 3.

6 Figure 7 is an upper plan view of a corner protector preform or blank usable with
7 the apparatus of Figure 1.

8 Figure 8 is a rear perspective view of the apparatus of Figure 2 showing a supply
9 of corner protector preforms or blanks of the type shown in Figure 7 in a stack preparatory to
10 feeding individual preforms into a clamping position on the apparatus.

11 Figure 9 is a rear perspective view similar to that of Figure 8, but showing an
12 individual corner protector preform advanced to a clamping location, and showing a corner
13 protector in a stack from which the individual corner protector was advanced.

14 Figure 10 is a view similar to that of Figure 9, but showing a corner of a picture
15 frame inserted into a clamping jig comprising part of the apparatus, the picture frame corner
16 being positioned above the individual corner protector preform of Figure 9, and showing a
17 clamp bar of the clamping jig brought down into compressive contact with the upper surface
18 of the picture frame.

19 Figure 11 is a view similar to that of Figure 10, but showing streams of adhesive
20 issuing from the adhesive applicator head of Figures 3 through 6, the streams impinging on
21 the upper surface of a channel member of the picture frame to thereby deposit thereon a first
22 adhesive blob consisting of two glue dots.

23 Figure 12 is a view similar to that of Figures 10 and 11, but showing a first corner
24 flap actuator comprising part of the apparatus in an upwardly actuated position.

25 Figure 13 is a view of the apparatus of Figure 1 similar to that of Figure 12, but
26 showing a fold-effecting arm of the first corner flap actuator rotated to contact and fold down
27 a securement flap of the corner protector preform into a position overlaying the picture frame.
28

Figure 14 is a view similar to that of Figure 13, but showing streams of adhesive issuing from the adhesive applicator head of Figures 2 through 6, the streams impinging on the upper surface of the securement flap to thereby deposit thereon a second adhesive blob consisting of two glue dots.

Figure 15 is a view of the apparatus similar to that of Figure 13, but showing a second corner flap actuator of the apparatus in an upwardly actuated position.

Figure 16 is a view of the apparatus of Figure 1 similar to that of Figure 15, but showing a fold-effecting arm of the second corner flap actuator rotated to contact and fold down a triangularly-shaped upper cover flap of the corner protector preform into a position overlying the securement flap of the corner protector preform.

Figure 17 is a view of the apparatus of Figure 1 similar to that of Figure 16, but showing the fold-effecting arm of the first corner flap actuator rotated back into an inactive, home position, and showing an adhesive applicator head comprising part of the apparatus actuated downwardly to thereby press a flat lower portion of the head forward of nozzles protruding downwardly from the head into compressive contact with the upper surface of that portion of the second, triangularly-shaped upper cover flap overlying the securement flap of the corner protector preform, thereby pressing the glue dots between the flaps together to thereby adhere the flaps together and thereby pressing the lower surface of the securement flap against the glue dots on the picture frame channel molding, thereby adhering the securement flap to the picture frame.

Figure 18 is a fragmentary side elevation view of the apparatus of Figure 17, showing the applicator head on an enlarged scale, but in a partially lowered position.

Figure 19 is a view similar to that of Figure 18, but showing the applicator head in a fully lowered position, as shown in Figure 17.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figures 1-19 depict a method and apparatus according to the present invention for adhesively bonding corner protectors onto picture frames and the like. The structure and function of certain portions of the apparatus according to the present invention are described

in detail in the present inventor's U.S. Patent No. 6,018,934, the entire specification, claims, drawings, and abstract which are hereby incorporated by reference into the present application.

Referring now to Figures 1 and 2, an apparatus 20 for adhesively bonding corner protectors onto the corners of picture frames and the like may be seen to include a corner protector installation mechanism 30. Mechanism 30 is similar in structure and function to the apparatus disclosed in U.S. Patent No. 6,018,934. Notably, however, as will be described in detail below, mechanism 30 according to the present invention utilizes an adhesive dispensing gun rather than the staple gun disclosed in the '934 patent. Thus, corner protector installation mechanism 30, in contrast to the apparatus disclosed in the '934 patent, can be used to install corner protectors on frames, such as metal or plastic frames, where it would not be feasible to staple the protector to the frame.

As shown in Figures 1 and 2, corner protector installation mechanism 30 includes a generally rectangular box-shaped enclosure 31 surmounted by a generally flat, upper base plate or work table 32. As may be seen best by referring to Figure 1, apparatus 30 includes an elongated, generally straight frame holder/clamping jig 33 mounted on the upper surface 34 of work table 32. Preferably, clamping jig 33 is disposed obliquely, e.g., at 45 degrees, with respect to the rectangular plan-view shape of work table 32. As shown in Figures 1, 8, 10 and 18, clamping jig 33 is spaced above upper surface 34 of table 32, and includes a longitudinally elongated, horizontally disposed, generally rectangular-shaped upper straight beam member 35, supported at opposite transverse ends thereof by a pair of laterally opposed, left and right guide plates 36L, 36R, respectively. Guide plates 36 have flat and parallel lower and upper surfaces, 236 and 237, these surfaces supporting clamp beam member 35 so that its lower surface 37 is parallel to and spaced above upper surface 34 of work table 32.

As shown in Figure 1, enclosure 31 of mechanism 30 has parallel, vertically disposed left and right side panels 72 and 73, which are perpendicular to front and rear vertically disposed panels 75, 74. Front panel 75 is preferably joined to left and right side panels 72, 73 by left and right vertically disposed transition panels 28, 29. The latter are

1 obliquely angled to front panel 75, e.g., at 45 degrees. This construction enables pairs of
 2 mechanisms 30 to be oriented with longitudinal axes of the mechanism, defined by a horizontal
 3 line centered in work table 32 and perpendicular to front panel 75, perpendicular to one
 4 another, with transition panels 29, 28 of mechanisms 20 spaced closely next to one another.
 5 Thus arranged, pairs of mechanisms 30 may optionally be employed in tandem, in a manner
 6 similar to that described in co-pending application Serial No. 09/687,358, filed 10/13/00, the
 7 entire disclosure of which is hereby incorporated by reference into this present application.

8 As shown in Figures 1 and 18, left and right guide plates 36L and 36R have inner
 9 longitudinally disposed vertical wall surfaces 238L and 238R, respectively. If extended
 10 inwardly or rearwardly towards the center of work table 32, inner vertical surfaces 238L and
 11 238R of guide plates 36L and 36R would intersect to form a right angle corner. However, as
 12 shown in Figures 1, 2, and 18, inner ends of guide plates 36L and 36R are truncated by an
 13 obliquely disposed cutting plane which forms obliquely disposed inner vertical transverse face
 14 walls 239L and 239R, respectively, that are coplanar with the cutting plane, and angled at 45
 15 degrees to inner vertical side walls 238L and 238R. Thus arranged, inner vertical side walls
 16 238L and 238R form guide surfaces along which may be slid the outer side walls of side
 17 channel members or moldings of a rectangular picture frame that intersect each other at a
 18 ninety-degree corner. A laterally disposed space 240 between opposed inner corners 241L
 19 and 241R of guide plates 36L and 36R allows the corner of a picture frame to protrude
 20 inwardly beyond inner face walls 239L and 239R of the guide plates.

21 As may be seen best by referring to Figures 1, 8, 10, and 18, clamping jig 33
 22 includes a horizontally disposed, elongated straight clamp bar 38 located below and in vertical
 23 alignment with clamp beam member 35. Clamp bar 38 is vertically movably held with respect
 24 to clamp beam member 35. Thus, as shown in Figures 1, 8, and 18, clamping jig 33 includes
 25 a linear actuator comprising a double acting pneumatic cylinder 40, for raising and lowering
 26 clamp bar 38. Clamp bar cylinder 40 is mounted on the upper surface 41 of clamping jig
 27 support beam 35, and has a piston rod 42 which protrudes vertically downwards through a
 28 bore 43 provided through the thickness dimension of the support beam. The lower end of

1 piston rod 42 has a square transverse sectional shape which protrudes through a similarly
2 shaped bore through clamp bar 38, and is secured to the clamp bar by a screw 39. Since
3 pneumatic cylinder 40 is of the type in which piston rod 42 is non-rotatable, clamp bar 38 is
4 maintained in a fixed horizontal orientation when moved vertically with respect to work table
5 32.

6 As shown in Figures 2 and 18, clamp bar cylinder 40 has an upper pressurized
7 "down" air inlet port 44 connected to a first "down" air inlet hose 45, and a second, lower, "up"
8 air inlet port 46 connected to a second, "up" air inlet hose 47. Hoses 45 and 47 connect to
9 tubular fittings 48 and 49 which protrude downwards through upper surface 34 of work table
10 32, to control valves and a source of pressurized air, as will be discussed in detail below.
11 When pressurized air is supplied to "up" inlet port 46 of clamp air cylinder 40, pressurized air
12 on the lower side of a piston within the cylinder forces the piston, attached piston rod 42, and
13 attached clamp bar 38 upwards to an upper, unlocked position, as shown in Figure 1.
14 Conversely, when pressurized air is supplied to "down" inlet port 44 of clamp air cylinder 40,
15 pressurized air on the upper side of the piston within the cylinder forces the piston and clamp
16 bar 38 downwards to a lower position in clamping contact with a picture frame A, as shown in
17 Figure 10.

18 A preferred embodiment of mechanism 30 according to the present invention
19 includes a feeder mechanism 70 for automatically feeding a single corner protector preform
20 50 at a time to a pre-determined position beneath clamping bar 38 of clamping jig 33, prior to
21 inserting a frame to be protected into the clamping jig. The structure and function of feeder
22 mechanism 70 may be best understood by first reviewing the construction of corner protector
23 preforms 50 used with apparatus 30. Figure 7, shows a corner protector preform 50 of the
24 type the apparatus 30 is intended to be used with.

25 As shown in Figure 7, preform 50 is made of a thin sheet of readily bendable
26 material, such as corrugated cardboard. Preform 50 has two laterally mirror symmetric, left
27 and right right triangularly-shaped panel sections bendable out the plane of the sheet to form
28 lower and upper triangular cover flaps 51 and 52, respectively. In the orientation of preform

50 shown in Figure 7, flap 51 is on the left-hand side of the figure, and will be referred to as the left-hand flap as a matter of convenience throughout the ensuing discussion. Left and right, lower and upper triangular cover flaps 51 and 52 have collinear horizontal bases 53 and 54 joined at their respective ninety degree corner angles to opposite vertical sides 55 and 56 of a vertically elongated, rectangular panel section comprising an inner spine flap 57, which has a base 58 collinear with the bases of the triangles. Thus shaped, preform 50 has an appearance approximating that of an isosceles triangle having a horizontal base 53-58-54 and an upper vertex truncated by a horizontal edge 59 parallel to the base.

Referring still to Figure 7, preform 50 may be seen to include a horizontally elongated, rectangularly shaped panel section comprising an outer spine flap 60 which depends downwardly from base 53 of left-hand triangular flap 51, and has the same width as that flap. A trapezoidally-shaped securement flap 61 depends downwardly from the bottom edge wall 62 of outer rectangular spine flap 60, the securement flap having an upper edge wall coextensive with bottom edge wall 62 of the outer spine flap, and a lower edge wall 63 parallel to but shorter than edge wall 62.

In a preferred embodiment of corner protector preform 50, the width of inner, vertical spine flap 57 and the height of outer, horizontal spine flap 60 are each equal to a common value which is slightly greater than the thickness of a typical picture frame, e.g., about 15/16 inch, for a frame thickness of 7/8 inch. As shown in Figure 7, preform 50 is preferably scored along edge walls 55 and 56 of inner, vertical spine flap 57, and along edge walls 53 and 62 of outer, horizontal spine flap 60. These score lines are located along boundaries between adjacent flaps, and facilitate folding the flaps out from the plane of a preform and around a picture frame corner, as will be explained below.

Referring again to Figures 2 and 8, corner protector feeder mechanism 70 may be seen to include a longitudinally elongated, rectangularly shaped guide plate 71 having a generally flat upper surface mounted above and parallel to upper surface 34 of work table 32. Guide plate 71 is oriented with its long axis parallel to left and right side walls 72 and 73 of enclosure 31, and protrudes rearwardly beyond rear side wall 74 of the enclosure. As shown

in Figures 1, 2, and 8, guide plate 71 of feeder mechanism 70 has through its thickness dimension a perforation 76 having substantially the same outline shape as corner protector preform 50. Guide plate 71 is spaced above upper surface 34 of table 32 by longitudinally disposed support ribs 82, at a distance slightly greater than the thickness of corner protector preform 50, e.g., 5/16 inch for preforms having a thickness of about 1/4 inch. Thus, a corner protector preform 50 placed conformally over perforation 76 will drop through the aperture onto work table surface 32, allowing the preform to be slid into operating position under clamping jig 33, as will be described in detail below.

As may be seen best by referring to Figure 9, feeder mechanism 70 includes a pusher plate 79 longitudinally slidably mounted in longitudinally disposed guideways consisting of grooves 80 provided in inner facing walls 81 of guide plate support ribs 82. Pusher plate 79 has a generally uniform thickness, and has a front edge wall 83 in which is formed a groove shaped complementarily to the lower edge wall of preform 50. Preferably, pusher plate 79 is made of DELRIN, NYLON, or a similar structural polymer that has good lubricity.

As shown in Figure 9, pusher plate 79 has protruding perpendicularly from a rear edge 85 thereof an elongated straight push rod member 84 which protrudes rearwardly of rear vertical wall panel 74 of enclosure 31. Push rod 84 is reciprocally and cyclically actuated longitudinally, i.e., perpendicularly to rear edge 85 of pusher plate 79, in a forward direction to feed a preform 50 forward under clamping jig 33, and rearwardly to retract front edge 83 of the pusher plate into alignment with the rear edge wall of aperture 76 through guide plate 71, to thereby enable a next preform 50 in a stack to drop through the aperture preparatory to its being fed forward for installation on another picture frame corner. In a preferred embodiment, push rod 84 is coupled to the piston of a double acting pneumatic cylinder (not shown) used to cyclically advance and retract pusher plate 79.

In a preferred embodiment of apparatus 20, as shown in Figure 1, corner protector installation mechanism 30 includes a plurality of vertically disposed guide rods 77 which protrude perpendicularly upwards from upper surface 34 of work table 32. Guide rods 77 define between tangents to the outer wall surfaces of inner facing sides of the rods a

1 uniform transverse cross-section, vertically disposed bore 78 which is vertically aligned with
2 guide plate perforation 76 and which is adapted to receive a vertical stack of preforms 50.

3 Referring now to Figures 1, 2 and 8, it may be seen that corner protector
4 installation mechanism 30 includes an adhesive dispensing apparatus 101 for dispersing
5 quantities of adhesive used for bonding corner protectors 50 to picture frames. In a preferred
6 embodiment, adhesive dispensing apparatus 101 includes a hot melt adhesive machine, such
7 as the Autotech Model AT15 Hotmelt Unit, manufactured by the Slautterback Corporation,
8 located at 5 Lower Ragsdale Drive, Monterey, CA 93940-5779. As shown in Figure 2, this
9 embodiment of an adhesive dispensing apparatus includes a machine 102 for melting solid
10 polymer sticks and pumping the molten polymer, and a thermally blanketed, high pressure
11 hose 103 for conveying hot, molten polymer adhesive to an applicator head 104. As shown
12 in Figures 3-6, applicator head 104 has a horizontally elongated body 105 including a generally
13 rectangular block-shaped front portion 106 having a flat, horizontally disposed lower surface
14 107 from which protrude one or preferably two adhesive dispensing nozzles 108. Hot melt
15 adhesive dispensing apparatus 101 includes a pressurized air hose 109 and electrical control
16 cable 110 which are interconnected between hot melt pumping machine 102 and applicator
17 head 104. Machine 102 includes a melting tank (not shown) located below a hinged lid 111
18 for receiving and melting sticks of hot melt polymer adhesive, such as H. B. Fuller type HL
19 9254 hot melt adhesive received into the tank. This type adhesive has a working temperature
20 range of about 270 °F to 325 °F. Machine 102 includes an internal heater, and internal control
21 mechanisms which, in response to electrical command signals supplied from an external
22 source, pump molten hot melt adhesive from the melting tank through delivery hose 103 to
23 applicator head 104. Internal control mechanisms within machine 102 also provide electric
24 signals through control cable 110 to applicator head which control pressurized air supplied to
25 the head through hose 109 which operate valves within the head, causing jets of pressurized
26 liquid hot melt adhesive to be sprayed from nozzles 108 upon receipt of an external command
27 signal.
28

1 surface. Arm 131 is oriented with a long, inner longitudinal edge 132 thereof parallel and adjacent to
2 a side of a picture frame protruding diagonally inwardly from beneath clamp bar 38 of clamping jig 33.

3 As may be seen best by referring to Figure 12, each flap holder arm 131 is
4 mounted on the upper transversely disposed horizontal end wall 133 of a vertically disposed,
5 cylindrically-shaped support post 134. Also, corner protector installation mechanism 30
6 includes a linear actuator for elevating support post 134 along its longitudinal axis, to thereby
7 elevate flap folder arm 131 attached to the upper end of the support post upwardly from its rest
8 position recessed in upper surface 34 of work table 31, and a rotary actuator for reciprocally
9 rotating elevator support post 134 about its longitudinal axis, to thereby rotate the flap folder
10 arm ninety degrees away from and back to its rest position, where the linear actuator retracts
11 the flap folder arm into recess 129.

12 Corner protector installation mechanism 30 according to the present invention
13 also includes preferably sensor means which provides a signal indicating that a corner of a
14 picture frame has been fully inserted into clamping jig 33, with the frame moldings adjacent the
15 corner parallel to and proximate inner vertical wall surfaces 238R, 238L of guide plates 36R,
16 36L.

17 Various types of proximity or optical sensors suitable for the foregoing purpose
18 are well known to those skilled in the art. In an example embodiment of apparatus 20 tested
19 by the present inventor, each sensor 170 consisted of a UZJ-111, fixed-focus type micro-photo
20 sensor, manufactured by Matsushita Electric Works, Ltd., Automation Controls Group, 1048
21 Kadoma, Osaka 571, Japan. That sensor contains an infrared light emitting diode and
22 phototransistor arranged within a circuit module with their optical axes generally parallel, and
23 their respective exit and entrance pupils adjacent each other behind an infrared window
24 comprising the outer face of the module. When a surface such as the outer surface of a
25 picture frame molding is positioned within about $5 \text{ mm} \pm 2.5 \text{ mm}$ of the outer face of the
26 sensor, an output transistor within the sensor is turned on, providing a logic TRUE current
27 through a load resistor connected in series with a collector supply voltage, and the emitter and
28 collector output terminals of the sensor.

As shown in Figure 1, a pair of sensors 170R, 170L of the type described above with their outer faces installed in guide plates 36R, 36L, flush with inner surfaces 238R, 238L of guide plates 36R, 36L, respectively, near the inner transverse vertical end walls 171R, 171L thereof, and near upper surface 34 of work table 32. Each sensor 170 produces a logic TRUE signal when a frame molding is parallel to and a predetermined distance from inner surface 238R, 238L adjacent the outer face of the sensor. Moreover, apparatus 20 includes an electronic AND circuit 172 for logically ANDING signals from the output terminals of two sensors 170R, 170L of corner protector installation mechanism 30. The output signal from the AND circuit is false when either of the 2 sensors 170R, 170L outputs a false signal, indicating that a picture frame molding near that sensor is not substantially close to and parallel to the sensor. However, when the corner of a frame has been fully inserted into and properly aligned with clamping jig 33 of corner protector installation mechanism 30 of apparatus 20. The logical AND circuit produces a TRUE output signal which initiates a sequence of automatic operations of the corner protector installation mechanism, which are described below. Electronic circuitry for performing the foregoing functions is well known to those skilled in the art, and therefore need not be described in further detail here. For example, such circuitry can be implemented in a Programmable Logic Controller, PLC 133, or a general purpose microprocessor or micro controller.

OPERATION OF THE INVENTION

In response to a TRUE output signal from AND circuit 172 when both sensors 170L, 170R produce TRUE output signals, Programmable Logic Controller (PLC) 133 issues in sequence drive signals to the various actuators of corner protector installer mechanism 30 of apparatus 20 according to the present invention, as follows:

1. Vertical stacks of corner protector preforms 50 are loaded into bores 78 between guide rods 77 of feeder mechanisms 70 of installer mechanism 30. (Figures 1 and 8)
2. Power is turned on and PLC 133 resets and checks mechanism 30 of apparatus 20, readying the PLC for outputting sequential drive signal commands to the various actuators of the apparatus. A program for the operational sequence of apparatus 20 is stored in

1 electronic memory means in PLC 133. This program can be executed via an internal or
2 external computer. (Figure 2)

3 3. Actuator cylinder 92 of feeder mechanism 70 in installer mechanism 30 is
4 actuated to reciprocate piston rod 94, thereby moving an individual corrugated corner
5 protector blank preform 50 forward into position below clamp bar 38 of the installer
6 mechanism. (Figure 9)

7 4. A first corner C1 of a picture frame A having left and right channel moldings D
8 and B is inserted into position beneath clamp bars 38 and over blank 50 of installer mechanism
9 30. (Figure 10)

10 5. Frame A is positioned relative to apparatus 20 so that corner C1 of the frame is
11 fully inserted into clamping jig 33 of mechanism 30. (Figure 10)

12 6. Sensors 170L, 170R of installer mechanism 30 output TRUE signals, causing
13 AND circuit 172 to output a TRUE signal, in turn causing PLC 123 to simultaneously issue
14 drive signals to the installer mechanism, as follows: (Figure 10)

15 7. Hold down clamp bar 38 of clamping jig 33 of mechanism 30 is forced downward
16 onto the adjacent molding channels D and B of frame A which intersect at corner C1. (Figure
17 10)

18 8. Hot melt adhesive machine 102 is then actuated, causing applicator head 104
19 to spray blobs E of semi-liquid hot melt adhesive onto the upper surface of left-hand frame
20 molding D. (Figure 11)

21 9. Blank preform 50 under corner C1 of frame A is automatically manipulated as
22 follows: First, rectangular outer spine flap 60 and securement flap 61 of preform 50 are bent
23 upwardly in unison into a vertically disposed orientation by elevating right-hand flap folder arm
24 131R of mechanism 30 from its recess 129R, with the flap folder arm in its clockwise position.
25 (Figure 12)

26 10. Securement flap 61 of preform 50 is bent inwardly and downwardly over left
27 frame channel D by rotating right-hand flap folder arm 131R counterclockwise. (Figure 13)

28

